HR-322 Estimating Design-Flood Discharges for Streams in Iowa Using Drainage-Basin Channel-Geometry Characteristics

Key Words: Streamflow, Stream Discharge, Channel-Geometry, Flooding

ABSTRACT

Drainage basin and channel geometry multiple-regression equations are presented for estimating design-flood discharges having recurrence intervals of 2, 5, 10, 25, 50, and 100 years at stream sites on rural, unregulated streams in Iowa. Design-flood discharge estimates determined by Pearson Type III analyses using data collected through the 1990 water year are reported for the 188 streamflow-gaging stations used in either the drainage basin or channel geometry regression analyses. Ordinary least-squares multiple-regression techniques were used to identify selected drainage basin and channel geometry characteristics and to delineate two channel geometry regions. Weighted least-squares multiple-regression techniques, which account for differences in the variance of flows at different gaging stations and for variable lengths in station records, were used to estimate the regression parameters.

Statewide drainage basin equations were developed from analyses of 164 streamflow--gaging stations. Drainage basin characteristics were quantified using a geographic information system procedure to process topographic maps and digital cartographic data. The significant characteristics identified for the drainage basin equations included contributing drainage area, relative relief, drainage frequency, and 2-year, 24-hour precipitation intensity. The average standard errors of prediction for the drainage-basin equations ranged from 38.6 to 50.2 percent. The geographic information system procedure expanded the capability to quantitatively relate drainage basin characteristics to the magnitude and frequency of floods for stream sites in Iowa and provides a flood estimation method that is independent of hydrologic regionalization.

Statewide and regional channel geometry regression equations were developed from analyses of 157 streamflow gaging stations. Channel geometry characteristics were measured onsite and on topographic maps. Statewide and regional channel geometry regression equations that are dependent on whether a stream has been channelized were developed on the basis of bankfull and active channel characteristics. The significant channel geometry characteristics identified for the statewide and regional regression equations included bankfull width and bankfull depth for natural channels unaffected by channel-ization, and 'active channel width for stabilized channels affected by channelization. The average standard errors of prediction ranged from 41.0 to 68.4 percent for the statewide channel geometry equations and from 30.3 to 70.0 percent for the regional channel geometry equations.

Procedures provided for applying the drainage basin and channel geometry regression equations depend on whether the design-flood discharge estimate is for a site on an ungaged stream, an ungaged site on a gaged stream, or a gaged site. When both a drainage basin and a channel geometry regression equation estimate are available for a stream site, a procedure is presented for determining a weighted average of the two flood estimates. The drainage basin regression equations are applicable to unregu-lated rural drainage areas less than 1,060 square miles, and the channel geometry regression equations are applicable to unregulated rural streams in Iowa with stabilized channels.